

# Response to reports of potential Crown of Thorns Seastar outbreak at Kahalu'u Bay



## Field Investigative Report



## Division of Aquatic Resources

**July 2023**

**Report compiled by:**

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**Response Dates:** 18 July 2023

**Team:** Initial response:

- Chris Teague, Ashley Wills

**Location:** In the waters outside of the menehune wall at Kahalu'u Bay, Hawai'i Island

- GPS coordinates (survey starting point): 19.58073, -155.96909

**Executive Summary:**

From July 11<sup>th</sup> through July 17<sup>th</sup>, the Division of Aquatic Resources (DAR) Kona office received reports from several sources that Crown of Thorns Seastars (COTS) and predation on multiple Cauliflower Coral (*Pocillopora meandrina*) colonies had been observed **outside of the Menehune wall or breakwater at Kahalu'u Beach Park, Hawai'i Island**. DAR staff conducted a response effort to evaluate the impact to resources and whether the density of COTS individuals was at the level of an outbreak and may warrant mitigation efforts. Staff members surveyed approximately 7,100 m<sup>2</sup> of reef area and observed a total of seven (7) COTS individuals and 346 colonies of coral with predation on at least a portion of the colony. DAR staff members computed a density of 0.000987 COTS per m<sup>2</sup> of reef. Because this density is well below the densities recorded during documented outbreaks in Hawai'i and elsewhere in the Pacific, it was determined that the COTS event at Kahalu'u is likely an aggregation of individuals rather than an outbreak.

**Relevant Background Information:**

Crown-of Thorns seastars (COTS, *Acanthaster planci*) are native to the Indo-Pacific and Hawai'i and are known to be natural and highly efficient coral predators. Healthy reef systems can support low density populations of COTS without leading to a notable loss of live coral cover (Prachette et al. 2014, Moran and De'ath 1992). Natural predators of adult COTS include the Triton's Trumpets (*Charonia tritonis*), triggerfishes, and pufferfishes (Prachette et al. 2014). Additional species of fish are suspected to be predators of COTS during the juvenile phases of the seastar life history (Prachette et al. 2014). In addition to these predators of the adult COTS, another natural control to their population is low survival rates of COTS larvae. COTS outbreaks most often occur when there is an unexpectedly high fertilization and survival of the larvae, thus leading to a boom in population on the reef (Prachette et al. 2014). There is also a hypothesis that increased nutrient concentrations could be a factor contributing to events of high larval survival by way of causing algal blooms and creating an abundant food supply for COTS larvae (Pearson & Endean 1969, Lucas 1973, Nishihira & Yamazato 1974, Birkeland 1982, Brodie 1992, Brodie et al. 2005, Fabricius et al. 2010). It typically takes about 2 years between the time of a successful spawning event and when the adult offspring from that event would be observable on the reef. This is because after successful fertilization and a brief larval stage, juvenile COTS typically recruit to the reef and stay within the matrix of the reef structure for protection from predators until they reach a size (~11 cm) at which their spines become an effective defense mechanism (Zann et al. 1987). Because there is such a delay between the spawning event that led to an outbreak and when an outbreak is apparent on the reef, there is still much about the cause of COTS outbreaks that is not well understood.

The high end of a non-outbreaking population is suggested to be 0.0015 COTS individuals per m<sup>2</sup> for mid shelf reefs in the Great Barrier Reef Australia, however three reefs with low coral cover of 1-10% reported outbreak populations of 0.0714, 0.0151, and 0.0078 COTS individuals per m<sup>2</sup> (Moran and De'ath 1992). Previous outbreaks in Hawai'i have been documented with densities of 0.34 per m<sup>2</sup> (Branham et al. 1971) on Moloka'i, and 0.29 per m<sup>2</sup> (Walsh et al. 2013) at Ka'ūpūlehu in West Hawai'i. Often, outbreaks can be short-lived, but can also cause extensive coral depletion. Previous observations have indicated that COTS outbreaks can result in the predation and death of 30% or more of existing live

coral cover (Moran and De'ath 1992). In Ka'ūpūlehu, COTS consumed over 80% of the Montiporid and Pocilloporid colonies in the immediate area of the DAR Kona West Hawai'i Aquarium Project monitoring site (Walsh et al. 2013). COTS are reported to display a feeding preference on certain species of corals, particularly those species within the *Acropora* and *Pocillopora* genera, but will feed on other species when preferred options are unavailable (Pratchett 2007). There is also evidence that COTS prefer predation of *P. meandrina* that are less than 10cm in size, even if the small colonies are not the dominant size available (Kenon and Aeby 2009). COTS are a native and natural predator to corals on reefs of Hawai'i, however high densities can result in a high loss of coral cover or elimination of specific coral species at an impacted site. Thus, it is worthwhile to conduct a response and consider intervention when COTS aggregations are found.

### **Description of initial reports:**

During mid July 2023, Division of Aquatic Resources (DAR) Kona staff received multiple reports of stark white colonies of *Pocillopora meandrina* (Cauliflower coral) observed outside the breakwater (Menehune wall) at Kahalu'u Bay, Hawai'i Island. In addition to white coral, the DAR staff received a report that 12 Crown of Thorns Seastars (COTS) had been observed in the same area and concern of a potential COTS outbreak was voiced. DAR staff members Ashley Wills and Chris Teague made plans to conduct a field assessment of the situation on their next scheduled day for field operations, July 18<sup>th</sup>, 2023. The reports received by DAR staff prior to their response effort are summarized as follows:

- Received 11 July 2023: Report of a sudden increase of COTS outside the Menehune Wall at Kahalu'u Bay in addition to white Cauliflower coral.
- Received 14 July 2023: Report of stark white cauliflower coral at Kahalu'u.
- Received 15 July 2023: Report that 12 COTS were observed outside the Menehune wall at Kahalu'u Bay on July 15<sup>th</sup> 2023.
- Received 17 July 2023: A [web link](#) was provided with video stories and text descriptions of the cauliflower coral and COTS outside the Menehune wall at Kahalu'u Bay. The compilation of information from multiple sources indicated that an initial COTS and stark white Cauliflower corals were observed on June 17<sup>th</sup>, 2023 and a total of 12 COTS were observed on July 15<sup>th</sup>, 2023.
- Received 17 July 2023: An additional [web link](#) was provided to a video of the COTS and white cauliflower corals observed outside of the Menehune wall, in addition to a report of the monitoring observations made of the Cauliflower coral population outside the wall between December 2020 and July 2023.

**Description of initial response:**

**Figure 1.** Outlined in white is the estimated survey area ( $\sim 7,100 \text{ m}^2$ ) that was observed by DAR staff members Teague and Wills on July 18<sup>th</sup>, 2023 outside the Menehune wall at Kahalu'u.

On Tuesday July 18<sup>th</sup>, 2023, at approximately 0800, DAR staff members Teague and Wills arrived at Kahalu'u Beach Park to perform a comprehensive survey and assessment of the potential COTS outbreak. Teague and Wills snorkeled to the northern point of the Menehune wall and followed the outer side of the wall south for approximately 45 minutes. After reaching the southernmost point of the survey area the team turned around and followed the edge of the reef flat on the way back to the tip of the wall to cover areas of the reef flat that were not surveyed on the swim out. During the effort approximately 7,094  $\text{m}^2$  of the reef flat was surveyed (Figure 1). Wills and Teague counted and identified the species of all the stark white coral colonies that were observed in addition to recording a count of both COTS (*Acanthaster planci*) and pincushion seastars (*Culcita novaeguineae*). Additionally, the team captured photos of the COTS individuals that were observed and photos of several of the colonies that were dead due to predation. Upon first sight of the stark white coral the staff dove down to inspect the colonies closely and ensure that the stark white coloration was a result of predation and the colony having been stripped of its tissue, rather than bleaching (transparent tissue present). The stark white colonies were confirmed to be a product of seastar predation and on some colonies there was still healthy normal colored tissue towards the base of the colonies or in areas that the predator did not reach (Figure 2). The staff also conducted a thorough search for seastar individuals, including taking time to check in cracks and under overhangs. Staff concluded the effort at around 0945, at which point the survey team snorkeled back through the bay towards the exit path. No COTS, nor colonies subject to predation were observed inshore of the Menehune wall so no data were recorded during the transit out to the wall and into shore.



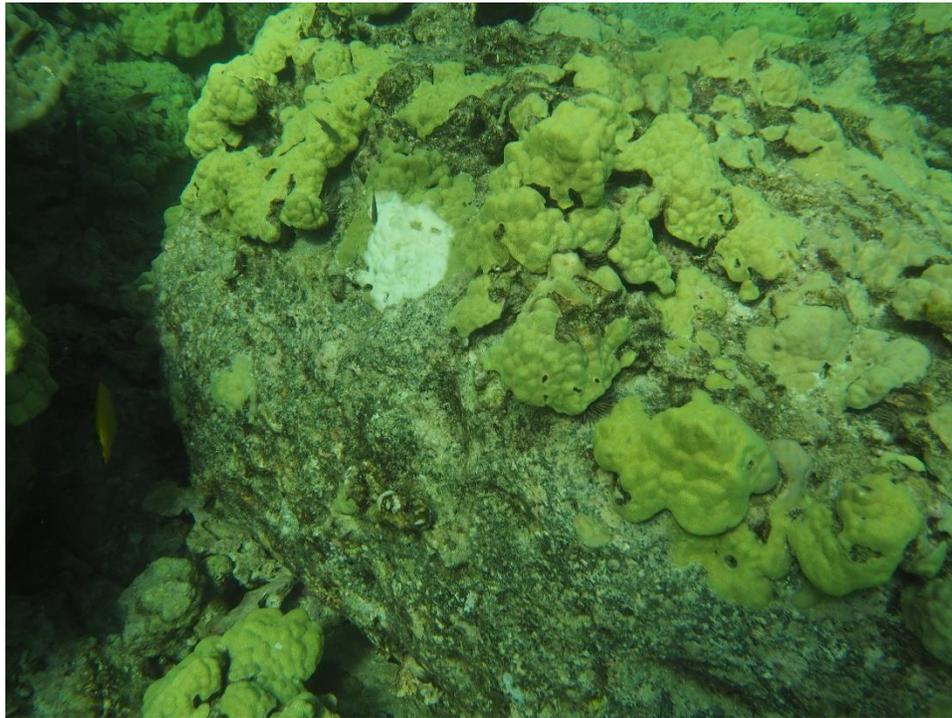
**Figure 2.** Partial predation by Crown of Thorns Seastar (*Acanthaster planci*) to two colonies of Cauliflower Coral (*Pocillopora meandrina*). Stark white portions of the colony are missing tissue due to predation and pink/orange portions of the colony have live tissue remaining. Observation made by DAR staff members, Teague and Wills on July 18<sup>th</sup>, 2023 outside the Menehune wall at Kahalu'u.

### **Description of habitat and observations:**

The habitat outside of the Menehune wall at Kahalu'u is a basalt and boulder reef that receives frequent wave action. On the outside of the wall there is a shallow (1-3m deep) shelf extending 20 to 60-meters seaward of the wall. At the end of the shelf, the reef drops vertically and flattens again at depths of approximately 6-8m. No predation was observed on the reef flat directly adjacent to the shelf except for one partial colony of lobe coral (*Porites lobata*, Figure 3). The benthic composition on the shelf was estimated to be less than 15 percent live coral cover intermixed with crustose coralline algae, turf algae, and some sections of dense of macroalgae. The dominant species of coral present is Cauliflower Coral (*Pocillopora meandrina*) and other species of coral observed include False Brain Coral (*Pavona varians*), Spotted Coral (*Leptastrea* spp.), Lobe Coral (*P. lobata*), and Rice coral (*Montipora capitata*). Species of coral subject to predation were *P. lobata*, *P. varians*, and primarily *P. meandrina* (Table 1). Of the 342 recently dead colonies recorded, only 3 were species other than *P. meandrina*. It was apparent that *P. meandrina* is the preferred source of food to the seastar predator(s) in the area. A total of seven COTS and seven pincushion seastars were observed throughout the survey effort.

**Table 1.** Total count of coral colonies subject to recent predation that were surveyed by DAR staff members, Teague and Wills on July 18<sup>th</sup>, 2023 outside the Menehune wall at Kahalu'u

Coral Species	Count of Coral Colonies Subject to Predation
<i>P. meandrina</i>	342
<i>P. lobata</i>	1
<i>P. varians</i>	3



**Figure 3.** Partial predation by Crown of Thorns Seastar (*Acanthaster planci*) to a large colony of Lobe Coral (*Porites lobata*). Observation made by DAR staff members, Teague and Wills on July 18<sup>th</sup>, 2023 outside the Menehune wall at Kahalu'u.

#### Discussion of Kahalu'u Observations:

During the survey efforts conducted by DAR Kona staff outside the Menehune wall at Kahalu'u, approximately 7,094 m<sup>2</sup> of reef was surveyed and seven COTS were recorded. This computes to a density of 0.000987 COTS per m<sup>2</sup> of reef. This density of COTS is roughly half the documented capacity (0.0015 COTS / m<sup>2</sup>) of a mid-shelf reef before the population density is considered to be at an outbreak level and an order of magnitude less than the lowest density recorded (0.0078 COTS / m<sup>2</sup>) on a low-coral-cover reef experiencing an outbreak (Pratchett et al. 2014). From this information, staff are inclined to consider the COTS situation at Kahalu'u an aggregation rather than an outbreak. It is possible that the COTS

aggregation occurred for the purpose of spawning. It has been reported that COTS migrate to shallow portions of the reef for spawning during warmer months (Babcock & Munday 1992). It is also possible that these individuals will migrate away and spread out on the reef or be subject to natural predation in the coming months. Notably, one of the COTS individuals observed during the survey effort showed extensive damage (Figure 4), however it was unclear if this was the result of natural predation or human intervention.

While the density of COTS observed outside of the Menehune Wall at Kahalu'u Bay during the survey effort is not at an outbreak level, the DAR staff don't want to dismiss concerns and would like to continue monitoring and assessing the situation.



**Figure 4.** Damaged Crown of Thorns Seastar (*Acanthaster planci*) observed by DAR staff members, Teague and Wills on July 18<sup>th</sup>, 2023 outside the Menehune wall at Kahalu'u.

#### **Next steps:**

The DAR Kona staff plan to continue periodic survey efforts outside the Menehune Wall at Kahalu'u Bay and monitor the COTS situation. The team will collect new survey data during each visit and investigate COTS density as well as percentage of live coral population affected to determine if the COTS population has reached an outbreak level or if a concerning percentage of the live coral population is dying as a result of predation. The DAR Kona staff wish to encourage partners to continue to conduct their own monitoring efforts outside the Menehune wall and share any related observations or concerns with Teague ([christopher.h.teague@hawaii.gov](mailto:christopher.h.teague@hawaii.gov)) and Wills ([apugh6@hawaii.edu](mailto:apugh6@hawaii.edu)).

## References

- Babcock, R.C. & Mundy C.N. 1992. Reproductive biology, spawning and field fertilization rates of *Acanthaster planci*. *Marine and Freshwater Research* 43, 525–533.
- Birkeland, C. 1982. Terrestrial runoff as a cause of outbreaks of *Acanthaster planci* (Echinodermata: Asteroidea). *Marine Biology* 69, 175–185.
- Brodie, J.E. 1992. Enhancement of larval and juvenile survival and recruitment in *Acanthaster planci* from the effects of terrestrial run-off: a review. *Australian Journal of Marine and Freshwater Research* 43, 539–554.
- Fabricius, K.E., Okaji, K. & De’ath, G. 2010. Three lines of evidence to link outbreaks of the crown-of-thorns seastar *Acanthaster planci* to the release of larval food limitation. *Coral Reefs* 29, 593–605.
- Kenyon J. & Aeby G. 2009. Localized Outbreak and Feeding Preferences of the Crown-of-Thorns Seastar *Acanthaster Planci* (Echinodermata, Asteroidea) on Reefs of Oahu, Hawaii. *Bulletin of Marine Science* 84(2). 199-209.
- Pearson, R.G. & Endean, R. 1969. A preliminary study of the coral predator *Acanthaster planci* (L.) (Asteroidea) on the Great Barrier Reef. *Fisheries Notes, Queensland Department of Harbours and Marine* 3, 27–55.
- Prachett M., Caballes C., Rivera-Posada J., Sweatman H. 2014. Limits to understanding and managing outbreaks of crown-of-thorns starfish (*Acanthaster* spp.). *Oceanography and marine biology: an annual review*, 52, 133-200.
- Lucas, J.S. 1973. Reproductive and larval biology of *Acanthaster planci* (L.) in Great Barrier Reef waters. *Micronesica* 9, 197–203.
- Nishihira, M. & Yamazato, K. 1974. Human interference with the coral reef community and *Acanthaster* infestation of Okinawa. *Proceedings of the Second International Coral Reef Symposium* 1, 577.
- Zann, L., Brodie, J., Berryman, C. & Naqasima, M. 1987. Recruitment, ecology, growth and behavior of juvenile *Acanthaster planci* (L.) (Echinodermata: Asteroidea). *Bulletin of Marine Science* 41, 561–575.